

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

LANL MASTER SPECIFICATION

When editing to suit project, author shall add job-specific requirements and delete only those portions that in no way apply to the activity (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the ESM Electrical POC.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within "stars" during editing.

Specification developed for ML-3 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

This specification addresses seismic protection requirements for Performance Category (PC) 1 and PC-2 electrical components. Refer to ESM Chapter 5 – *Structural* for seismic protection design requirements that are required for PC-1 and PC-2 components. Also refer to ESM Chapter 5 – *Structural* for additional seismic protection design requirements that will be required for PC-3 and PC-4 components.

Use this specification in conjunction with Section 13 4800 SOUND, VIBRATION, AND SEISMIC CONTROL.

PART 1 GENERAL

1.1 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Refer to Section 01 4219, Reference Standards, for date and publications to follow:
 - 1. AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
ASCE 7 Minimum Design Loads for Buildings and Other Structures
 - 2. INTERNATIONAL CODE COUNCIL
International Building Code (IBC)
 - 3. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 National Electric Code (NEC)
 - 4. NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)
NECA 1 Standard Practices for Good Workmanship in Electrical Contracting

1.2 SECTION INCLUDES

- A. Provide and install, hangers, supports, anchors, concrete bases, sleeves, inserts,

seals, and other positive fastenings for electrical components such that in-service loads and seismic forces are safely transferred to the structure and relative seismic displacements of supporting structures are adequately accommodated.

Delete this article if seismic protection is not required.

1.3 SEISMIC PROTECTION

NOTE: The requirements for seismic protection measures described in this section apply to all electrical components except for the following:

- Electrical components where $I_p = 1.0$, and flexible connections between the components and associated conduits are provided, and the components are mounted at 4 ft or less above the floor, and the components weigh 400 lb or less.
- Electrical components weighing 20 lb or less where $I_p = 1.0$ and flexible connections between the components and associated conduits are provided.
- Electrical distribution systems weighing 5 lb/ft or less where $I_p = 1.0$.

Seismic restraints are not required for electrical conduit less than 2-1/2 inches trade size and not containing conductors for life-safety, safety-significant, or safety-class systems; provide seismic protection for all other interior conduit as specified.

Accomplish resistance to lateral forces induced by earthquakes without consideration of friction resulting from gravity loads.

Design the functional and physical interrelationship of components and their effect on each other so that the failure of an electrical component shall not cause the failure of a nearby life-safety, safety-significant, or safety class mechanical or electrical component.

Seismic Criteria: Use the following criteria to calculate seismic design forces and relative seismic relative displacements in accordance with the IBC and ASCE 7.

- Seismic Design Category = D
- S_{DS} = design spectral response acceleration at short periods
 - o $S_{DS} = 0.54g$
- Amplification, Response Modification and Importance factors (i.e., a_p , R_p , I_p) listed in ASCE 7:
 - o $a_p = 2.5$ for electrical distribution systems (e.g., busducts, conduit, cable tray, etc.)
 - o $a_p = 1.0$ for electrical equipment (e.g., switchgear, transformers, batteries, etc.)
 - o $a_p = 1.0$ for luminaries
 - o $R_p = 5.0$ for electrical distribution systems (e.g., busducts, conduit, cable tray, etc.)
 - o $R_p = 2.5$ for electrical equipment (e.g., switchgear, transformers, batteries, etc.)

- $R_p = 1.5$ for luminaries
- $R_p = 1.5$ for components anchored by shallow expansion anchors, shallow chemical anchors, or shallow (low deformability) cast-in-place anchors
- $I_p = 1.5$ for life safety related components (e.g., emergency generators, etc.)
- $I_p = 1.5$ for components with hazardous content (e.g., lead-acid batteries, etc.)
- $I_p = 1.5$ for safety class or safety significant components.
- $I_p = 1.0$ for all other components

- A. Provide and install seismic protection in accordance with the IBC, ASCE 7, and additional data furnished in this Section and Section 13 4800 Sound, Vibration and Seismic Control.

Edit the following article to match project conditions; add items to list as required; delete items not included in the Project. It may be necessary to note the equipment IDs for the particular items of equipment (e.g. GDE-1, SUS-B, etc.) that must meet the requirements of this article. Delete the article if there is no equipment with I_p greater than 1.0.

NOTE: Seismic protection does not guarantee that the equipment itself is rugged enough to survive earthquake shaking. When a piece of equipment is required to remain operational after an earthquake, consult the manufacturer regarding the capabilities of the equipment to withstand seismic loading.

- B. Equipment Qualification: The following equipment designated with I_p greater than 1.0 and furnished under this contract shall be certified by the manufacturer to withstand the total lateral seismic force and seismic relative displacements specified in the IBC or ASCE 7. Component manufacturer's certification shall be based on shake table testing or experience data (i.e., historical data demonstrating acceptable seismic performance), or by more rigorous analysis providing for equivalent safety. Required response spectra shall exceed 1.1 times the in-structure spectra determined in accordance with IBC AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

1. Engine-generator[s] [GDE-1]
2. Secondary Unit Substation[s] [SUS-B]
3. Transformer[s] [XFMR-3]
4. Switchboard[s] [SWBD-2]
5. Motor control center[s] [MCC-E]
6. [_____]

1.4 QUALITY ASSURANCE

- A. Provide, and install hangers, supports, and seismic protection that conforms to the requirements of the following codes and standards:
 - 1. NFPA 70
 - 2. IBC
 - 3. ASCE 7
 - 4. NECA 1
- B. Where Underwriters Laboratories, Inc. has requirements for such products, provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for the application, installation condition, and the environment in which installed.

NOTE: Edit the following article to match project requirements.

1.5 SUBMITTALS

- A. Submit the following in accordance with the provisions of Section 01 3300 Submittal Procedures.
- B. Catalog Data: Submit catalog data for each type of product specified. Include information substantiating equivalent corrosion resistance to zinc coated steel of alternative treatment, finish, or inherent material characteristic.

Edit the following article to match project conditions; add items to list as required; delete items not included in the Project.

- C. Shop Drawings: Submit shop drawings showing details of fabricated hangers, supports, and seismic protection. Provide detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

Edit the following article to match project conditions; delete if not required by Project.

- D. Certifications: Submit manufacturer's certification of compliance indicating compliance with Clause 9.6.3.6 of ASCE 7 for electrical components with I_p greater than 1.0. Submit shake-table test results or experience data with certifications.

1.6 RECEIVING, STORING AND PROTECTING

- A. Receive, store, and protect, and handle products according to NECA 1.

PART 2 PRODUCTS

2.1 SUBSTITUTIONS

- A. Alternate products may be accepted; follow Section 01 2500, Substitution Procedures.
- B. As is the case with all LANL projects, substitutions are permitted unless noted otherwise; however, "approved equal" non-building structures and seismically protected non-structural components must be reviewed and approved by the design structural engineer.

Delete the following article if seismic protection is not referred.

2.2 GENERAL

- A. Refer to Section 13 4800, Sound, Vibration and Seismic Control. for general seismic protection materials and equipment.

2.3 COATINGS

- A. Provide products for use indoors protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.
- B. Provide products for use outdoors or in damp or corrosive indoor locations with hot-dip galvanized coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.

2.4 RACEWAY SUPPORTING DEVICES

- A. Provide supports as described below for the installation of raceway systems.
- B. Use pressed steel, single bolt hangers to support individual RGS, IMC or EMT

conduit runs from threaded rods or beam clamps. Manufacturer: Steel City "6H Series".

- C. For individual runs of EMT up to 1-inch trade size above accessible ceilings, use spring steel conduit clips with positive snap closure. Manufacturer: ERICO CADDY "M Series".
- D. Use malleable iron conduit clamps to secure individual RGS, IMC or EMT conduit runs across, parallel, or perpendicular to beams, channels and angle supports. Manufacturer: Steel City "RC, EC, and PC Series".
- E. Use two-piece carbon steel riser clamps for individual vertical conduits passing through floors. Manufacturer: Kindorf "C-210 Series".
- F. Use snap-on type one-hole steel straps to secure individual conduits up to 2-inch trade size to flat, dry interior surfaces. Manufacturer: T&B "1210 Series" for RGS and IMC and "4100 Series" for EMT.
- G. Use one-hole malleable iron straps to secure individual conduits up to 4-inch trade size to flat, dry interior surfaces. Manufacturer: T&B "1275 Series".
- H. Use one-hole malleable iron straps and conduit spacers to secure individual conduits to flat exterior or damp flat interior surfaces. Manufacturer: T&B "1275 Series" straps with 1350 Series" spacers.
- I. Support multiple parallel horizontal conduits with trapeze hangers fabricated from framing channel materials specified below.

2.5 OUTLET BOX SUPPORTING DEVICES

- A. Provide pre-fabricated sheet steel brackets to support outlet boxes from metal studs in dry-wall construction.
- B. Provide brackets for single-outlet boxes that are inset to allow for dry-wall ring and have a far-side support leg. Manufacturer: ERICO CADDY "H Series".
- C. Provide brackets for multiple outlet boxes that are inset to allow for dry-wall rings and span from stud to stud. Manufacturer: ERICO CADDY "RBS Series".

2.6 FASTENERS

- A. Provide fasteners of the types, materials, and construction features as follows:

1. Pre-set concrete inserts:

- a. Continuous inserts: Design load 2000 lbs per ft of insert length with safety factor of 3 in 3000 psi concrete. Manufacturer: B-Line "B221"
- b. Spot inserts: NRTL-listed with design load of 1000 lb. Manufacturer: B-Line "B2506"

- c. Metal deck bolts: Adjustable with bolt sizes from 3/8 inch to 3/4 inch. Manufacturer: B-Line "B3019"
- 2. Expansion anchors: NRTL listed carbon steel wedge type studs. Manufacturer: Hilti "Kwik Bolt III". Note restrictions on use of expansion bolts in Part 3 of this Section.
- 3. Toggle bolts: All steel-spring head type.
- 4. Masonry screw anchors: Case hardened steel. Manufacturer: Hilti "Kwik-Con II".
- 5. Powder-Driven Threaded Studs: Heat-treated steel, designed for the intended service. Note restrictions on use of powder-driven fasteners in Part 3 of this Section.
- 6. Beam clamps: NRTL-listed, or compliant with Federal Specification WW-H-171E, or compliant with Manufacturers' Standardization Society SP-69 and SP-58.

2.7 FRAMING CHANNEL SYSTEMS

- A. Provide U-channel framing systems that conform to the Metal Framing Manufacturers' Association standards publication MFMA-4 and are fabricated using minimum 12-gage steel, with 9/16-inch-diameter holes, from 1-1/2 to 1-7/8 inches on center, in the surface opposite the "U" opening.
- B. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer. Use two-piece, single bolt type conduit straps on U-channel supports.
- C. Manufacturers: Unistrut, B-Line, Superstrut.

2.8 FABRICATED SUPPORTING DEVICES

- A. Provide shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Provide steel brackets fabricated from angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

2.9 SLEEVES AND SEALS

- A. Provide pipe sleeves of one of the following:
 - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snap-lock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
 - a. 3-inch and smaller: 20-gage.

- b. 4-inch to 6-inch: 16-gage.
 - c. over 6-inch: 14-gage.
2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe two pipe sizes larger than the penetrating raceway.
 3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe two pipe sizes larger than the penetrating raceway.

Delete B except where watertight seals are required. Coordinate with Drawings and Section 26 0533, Raceways and Boxes for Electrical Systems.

- B. Provide factory-fabricated, watertight, conduit-sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Provide seals complete with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, clamps, and cap screws. Manufacturer: O-Z/Gedney "Type CSM Series".

2.10 CONCRETE FORMWORK

Edit A to match specification sections used in Division 3.

- A. Refer to Section 03 3001, Reinforced Concrete.

2.11 CONCRETE REINFORCEMENT

Edit A to match specification sections used in Division 3.

- A. Refer to Section 03 3001, Reinforced Concrete.

2.12 CAST-IN-PLACE CONCRETE

Edit A to match specification sections used in Division 3.

- A. Refer to Section 03 3001, Reinforced Concrete.

PART 3 EXECUTION

3.1 GENERAL

NOTE: Locate each item of rigid electrical equipment entirely on one side only of a building expansion joint.

Piping, cable trays, etc., which cross an expansion joint to rigid electrical equipment, shall have flexible joints that are capable of accommodating calculated thermal and seismic displacements.

Delete A if seismic protection is not required.

- A. Refer to Section 13 4800, Seismic Protection for general seismic protection installation requirements.
- B. Install hangers, supports, and seismic protection according to the NEC, IBC, ASCE 7, NECA 1, and requirements in this Section.
- C. Conform to manufacturer's instructions and recommendations for selection and installation of hangers, supports, and seismic protection.
- D. Do not use wire or perforated strap for permanent electrical supports.
- E. Attach each item of electrical equipment as shown.
- F. Provide and install electrical conduit, busways, cable trays, etc. which cross an expansion joint to rigid electrical equipment, with flexible joints as shown.
- G. Do not support conduits, busways, cable trays, etc. from ceiling suspension wires.

3.2 EXAMINATION

- A. Examine surfaces to receive hangers, supports, and seismic protection for compliance with installation tolerances and other conditions affecting performance of the system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 SEISMIC RELATIVE DISPLACEMENTS

NOTE: Using the procedures in ASCE 7, the author will determine the expected seismic relative displacements and drift ratios.

Joints for vertical piping, conduits, etc. between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators must be capable of accommodating the required relative displacements.

Horizontal piping, conduit, etc. across expansion joints must be capable of accommodating the resultant of the drifts of each building unit in each orthogonal direction.

Piping, conduits, etc. with manufactured ball joints must be capable of accommodating the seismic drift (i.e., deflection per unit of height above the base where the seismic separation occurs).

Insert the required flexibility (e.g., inches of relative displacement, etc.) in the blank space.

Delete this article if seismic protection is not required.

- A. Joints capable of accommodating [____] shall be provided and installed for vertical conduit, busways, cable trays, etc. between floors of the building, where conduits, etc. pass through a building seismic or expansion joint, or where rigidly supported conduits, etc. connect to equipment with vibration isolators.
- B. Conduit, busways, cable trays, etc. capable of accommodating [____] shall be provided and installed for horizontal runs across expansion joints.

3.4 RACEWAY SUPPORTS.

- A. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
- B. Support three or more parallel runs of horizontal raceways together on trapeze hangers.
- C. Support individual horizontal raceways by separate pipe hangers.
- D. Do not support conduits from ceiling suspension wires.

3.5 BOXES AND CABINETS

- A. Support sheet metal boxes directly from the building structure, or by approved brackets or bar hangers, as shown. Where bar hangers are used, attach the bar to structure on opposite sides of the box.
- B. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support.
- C. Install surface-mounted cabinets and panelboards as shown.

 Edit the following article to match project conditions; delete if concrete bases are not required.

3.6 CONCRETE BASES

- A. Install a reinforced concrete base, not less than 4 inches high, for each piece of floor- mounted electrical equipment.

 Edit the following article to match project conditions; delete if not required. Use concrete bases with a permanent steel perimeter for heavy equipment such as unit substations, transformers 300 kVA and larger, engine generators, etc. Edit references to concrete work to match sections used in Division 3 of the Project Specifications.

- B. Support each [unit substation] [engine generator] [rotary UPS] [transformers 300 kVA and larger] [] on a concrete equipment base with a permanent steel perimeter frame.

1. Form base using ASTM A-36 steel channels.
2. Construct base not less than 4 inches larger in both directions than supported equipment. Miter and weld corners and provide cross bracing. Anchor or key to floor slab.
3. Install reinforcing bars tied to frame, and place anchor bolts, floor sills and sleeves using manufacturer's installation template. Refer to Section 03 3001, Reinforced Concrete.
4. Place concrete and provide a steel trowel finish on top. Refer to Section 03 3001, Reinforced Concrete.
5. Clean exposed steel frames and apply 2 coats of rust-preventative metal primer and 2 coats of exterior, gloss, alkyd enamel in color selected by the Architect.

Edit the following article to match project conditions; delete if not required. Use concrete bases without a permanent steel perimeter for relatively light floor-mounted equipment such as transformers smaller than 300 kVA, motor control centers, switchboards, etc. Edit references to concrete work to match sections used in Division 3 of the Project Specifications.

- C. Support each [switchboard] [power panelboard] [motor control center] [transformers smaller than 300 kVA] [] on a formed concrete equipment base.

1. Form concrete equipment bases using framing lumber with form release compounds. Refer to Section 03 3001, Reinforced Concrete.
2. Construct concrete base not less than 4 inches larger in both directions than supported unit.
3. Install reinforcing bars, and place anchor bolts, floor sills and sleeves using manufacturer's installation template. Refer to Section 03 3001, Reinforced Concrete.
4. Place concrete and provide a steel trowel finish on top; chamfer top edges and corners. Refer to Section 03 3001, Reinforced Concrete.

- D. Cure concrete not less than seven days before installing equipment.

3.7 ANCHOR BOLTS

- A. Refer to Section 03 1505, Concrete Anchors.

3.8 HANGER RODS

Coordinate the following article with the Drawings. Delete if there is no suspended equipment.

- A. Use threaded hanger rods of the sizes indicated on the Drawings to support suspended equipment.

3.9 SWAY BRACES FOR CONDUIT, BUS DUCTS, CABLE TRAYS, ETC. (i.e., ITEMS)

Sway braces are required to prevent movement of the items under seismic loading.

Design of sway braces for an item run shall be such that attachment to two dissimilar structural elements of a building that may respond differentially during an earthquake does not result, unless a flexible joint is part of the design. Reference paragraph SEISMIC RELATIVE DISPLACEMENTS.

Braces are required in both the longitudinal and transverse directions, relative to the axis of the item.

The bracing shall not interfere with thermal expansion requirements for the items as described in other sections of these specifications.

Delete this article if seismic protection is not required.

A. Transverse Sway Bracing for Items

NOTE: Supports for flexible items must consider an additional amplification if the item is in resonance with the building.

All runs (length of item between end joints) shall have a minimum of two transverse braces.

1. Transverse sway bracing shall be provided and installed as shown.

B. Longitudinal Sway Bracing for Items

NOTE: Design longitudinal sway braces for items to meet the force and displacement provisions of ASCE 7. In addition, the design should take into account thermal expansion such that the sway braces do not interfere with expansion requirements.

All runs (length of item between end joints) shall have one longitudinal brace minimum.

Branch lines, walls, or floors shall not be used as sway braces.

1. Longitudinal sway bracing shall be provided and installed as shown.

C. Vertical Runs

NOTE: Design sway braces for vertical runs of items to meet the force and displacement provisions of ASCE 7, such that bracing occurs above the center of gravity of the segment being braced.

All runs (length of item between end joints) shall have one longitudinal brace minimum.

Branch lines, walls, or floors shall not be used as sway braces.

1. Run is defined as length of item between end joints.
2. Sway bracing for vertical runs of items shall be provided and installed as shown.

D. Anchor Rods, Angles and Bars

1. Anchor rods, angles, and bars shall be bolted to clamps at one end and to cast-in-place concrete or masonry insert, or clip angles bolted to the steel structure, on the other end.
2. Provide and install bolts for attachment of anchors to items and structure shall be as shown.
3. Rods shall be solid metal or pipe.

E. Clamps and Hangars

1. Clamps or hangers on uninsulated items shall be applied directly to item.
2. Clamps or hangers on insulated items shall be applied over insulation vapor barrier with high-density inserts and metal protection shields under each clamp/hangar.

F. Shell Type Anchors Post-installed in Reinforced Concrete

1. The use of lead-cinch drop in anchors is not allowed.

Edit the following article to match project requirements.

3.10 FASTENING

- A. Refer to Section 13 4800, Sound, Vibration, and Seismic Control.
- B. Refer to NECA 1 for components that do not require seismic protection.

3.11 SLEEVES AND SEALS

NOTE: The author will determine the amount of differential movement of conduits and cables at pipe sleeves passing through non-fire-rated walls and partitions and will indicate on the drawings the amount of clearance required between the conduit/cable and the sleeve based on deflection of the conduit/cable between sway braces on either side of the wall.

The author should avoid conduit/cable penetrations through fire-rated assemblies.

Edit A to match Project requirements.

- A. Provide and install sleeves in concrete slabs and walls and all other fire- rated floors and walls for raceways and cable installations.
- B. Sleeves through fire-rated-wall or -floor construction shall conform to the requirements of Section 07 8400, Firestopping. Follow manufacturer's instructions to restore original fire rating of wall or slab.
- C. Conduit/cable sleeves in interior non-fire-rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of conduit/cable without the conduit/cable striking the sleeve.

Edit the following article to match Project requirements.

- D. Provide and install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
- E. Request inspection of firestop installations by LANL both before and after installation of firestop materials.

Delete the following article is seismic protection is not required.

3.12 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

- A. Refer to Section 13 4800, Sound, Vibration and Seismic Control.

END OF SECTION

Do not delete the following reference information.

FOR LANL USE ONLY

This project specification is based on LANL Master Specification 26 0529 Rev. 0, dated January 6, 2006.